NOTES ON COCCINELLIDS IN THE PACIFIC NORTHWEST

(Coleoptera)

L. P. ROCKWOOD[1]

Bureau of Entomology and Plant Quarantine,
Agricultural Research Administration,
United States Department of Agriculture

The effectiveness of coccinellids, or lady beetles, in the control of aphids is sometimes underestimated by economic entomologists, probably because it is customary to take note of them only in times of aphid outbreaks. Lady beetles, as well as other natural enemies of the aphids except fungus disease, may be inadequate for control at times when aphids have been given an unusual advantage by weather conditions. It would be better to think of these predaceous insects as ever present and helping to keep down aphid populations every year. Aphid outbreaks would probably be a yearly occurrence without them. As lady beetles are very susceptible to some insecticides, it would be well to consider the possible effect on their numbers of the chemical treatment of large areas.

On the other hand, some people believe that the importation of large numbers of lady beetles into their fields or orchards would be a cheap and easy means of controlling aphids on their property. Their confidence in the effectiveness of these predators has led them to invest in stocks of lady beetles that have been collected in distant areas. Davidson (1924), in California, demonstrated that this practice cannot be of value to the individual grower, because the imported beetles disperse widely after release. This rapid dispersal of imported beetles has also been noted by Packard and Campbell (1926) in the Antelope Valley of southern California, Knowlton *et al.* (1938) in Utah, Eddy (1939) in Louisiana, Garman (1936) in Connecticut, and Hedrick (1934) in New York. Whether or not the region would benefit if large numbers of lady bettles were brought into it would be very difficult to demonstrate.

The habit of some species of coccinellids of collecting in masses in certain restricted locations at certain times has rendered

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[1]Retired October 31, 1948. In addition to my own notes I have assembled and compiled the notes of several coworkers of the Bureau of Entomology and Plant Quarantine who were located at Forest Grove, Oregon, but I alone am responsible for this arrangement and the conclusions drawn. Among these coworkers were Mrs. S. K. Zimmerman (nee Keen), A. C. Burrill, Max M. Reeher, and T. R. Chamberlin.

their collection for exploitation comparatively easy. The tendency of these species is to return to the same sites year after year, even though the returning beetles themselves have had no previous association with that site. In the West such aggregations have been called lady beetle caches. These caches are susceptible to serious damage by fire at the hands of the ignorant or careless.

Caches, or masses, of lady beetles are much more common than is generally supposed, at least in the West. A. C. Burrill, with the help of employees of the United States Forest Service and others, accumulated reports of lady beetle caches during the period 1918 to 1920. By adding to these reports the definite records made by other workers, we have records of about 25 such caches scattered over the region west of the Cascade Mountains and east of the Coast Range divide, and about 45 in Oregon and Washington east of the Cascade Mountains. Doubtless there are many other cache sites in both regions which have never been reported, as these caches are not easy to discover except at certain opportune times. Similar caches in California were known, and beetle collections were made from some of them for many years (Carnes, 1912). They have also been reported in Nevada (Nunenmacher, 1910), in Utah (Knowlton *et al.* 1938), in Colorado (Gillette, 1923), in New Mexico (Douglass, 1930), in Michigan and in the southeastern United States (Sherman, 1938).

In the Pacific Northwest west of the Cascade Mountains, three species of *Hippodamia* are found in these caches—*quinquesignata* (Kirby), mostly of the spotless or nearly spotless form *ambigua*[2], *sinuata* Mulsant, mostly of the form *spuria* LeConte[2], and *convergens* Guérin-Méneville[2]. Caches of *quinquesignata* and *sinuata* occur in the same localities, on bald, dry hill tops, the highest in the region, such as Bald Peak in the Chehalem Hills about 10 miles south of Forest Grove (discovered by Miss Keen on April 29, 1922), and Peterson's Butte near Lebanon in Linn County (discovered by entomologists from Oregon State College in 1918). Although the caches of these two species occur together, they are not much intermingled, each species tending to bunch up with its own kind, *quinquesignata* usually a little higher up the slope than *sinuata*. They occur well down in the crowns of a bunch grass, fescue, or around wild rose bushes, blackberry vines, and poison

[2]Determinations were made by P. H. Timberlake in 1920.

oak (mostly *sinuata* in blackberry vines and poison oak) on southwest-facing slopes. Such caches are not easily discovered except when the beetles are assembling in September and October, when basking in the sun on sunny days in early spring, or when leaving in March or April. When the beetles in the bunch grass are disturbed, they "boil up" in large numbers from each grass crown, except in cold weather when they are torpid. *H. sinuata* are usually more numerous than *quinquesignata* in these caches. The mating, or attempted mating, of male *sinuata* with female *quinquesignata* is frequently observed when the beetles are leaving the cache. Pale red *sinuata spuria*[2] with greatly reduced spots, sometimes altogether spotless, have been found in some numbers in the Bald Peak cache and also in the cache on Peterson's Butte. Typical *qinquesignata* are a brilliant red, whereas the red of *sinuata* is usually much faded, sometimes nearly to yellow.

Cache sites of *Hippodamia convergens* in western Oregon are quite different—usually near water, on stumps, bracken, bushes and small trees in cold damp canyons, such as Clear Creek Canyon six miles northwest of Forest Grove, or on rushes in swampy spots —and the exposure in general is eastern. In a small swampy spot near the Forest Grove reservoir, on October 20, 1926, the beetles were in clumps at the tops of the rushes, giving the impression of exotic bloom. In February 1935, T. R. Chamberlin found a small cache of mostly spotless *convergens* on rushes in a marshy spot on the valley level at the foot of a slight east-facing slope near Rickreall in Polk County. Specimens taken here so closely resembled the spotless form of *quinquesignata* that we were not sure of the species until mounts of the male genitalia proved to agree with Timberlake's (1919) description of *convergens*. Ewing (1913) reported masses of lady beetles on the summit of Mt. Chintimini (now called Mary's Peak), the highest point in the Coast Range of Oregon. He stated that some of the beetles he found cached there were *spuria* LeConte and that others were *convergens* Guérin-Méneville.

The late R. C. Treherne wrote (Nov. 5, 1921) that the lady beetle caches in British Columbia "that face the west are, I believe, *H. 5-signata*, whereas the one facing the east is probably *H. convergens*." This idea had not occurred to us, but our observations on the sites that we have seen confirm Treherne's tentative theory. It would be desirable for someone to make a study of this interest-

ing phenomenon of massing by lady beetles, if he were careful to make accurate determinations. The determination of the species of this genus is very difficult, and the male genitalia must be studied to verify them (Timberlake, 1919, and Chapin, 1946).

Most of the caches that have been reported in the area east of the Cascade Mountains are presumably of *Hippodamia convergens*, but we have seen few specimens from such caches. A form of *caseyi* Johnson that is spotted like *convergens* was noted in numbers near Wenatchee, Washington (Timberlake, 1919). Caches are known to occur on the isolated buttes of the Palouse region as well as in the Blue Mountains. In Okanogan County, Washington, many of the caches, judging from specimens collected by A. C. Burrill in 1918 and 1919, are of *caseyi* Johnson[2]. Knowlton *et al.* (1938) recorded the finding of caches of *quinquesignata* in Utah.

No one knows from how far the beetles come to these caches. We have observed that *Hippodamia sinuata* and *quinquesignata* are not present in the fields near Forest Grove until the beetles have begun to leave the caches on Bald Peak, 10 miles away. It is quite possible that the beetles travel long distances to reach some of the caches, particularly those in the high mountains. The beetles usually come to the caches on Bald Peak in September and October, but in 1931, some were observed in the grass crowns as early as July 16. In that year previously large populations of pea aphids on annual legumes were very greatly reduced in May or in early June. On July 4, 1926, after a similar sequence of pea aphid populations, a picnic party observed *convergens* massing in Clear Creek Canyon. Sherman (1938) has suggested that hibernation does not seem to be the primary reason for massing in the mountains of the Southeastern States. It seems possible that a sudden failure of the food supply might lead some of the beetles to go to the caches earlier than usual. Such sites may afford better chances for survival without food and with a minimum of activity than do fields at lower levels or in warmer situations. The beetles usually leave the caches in western Oregon in April, but sometimes as early as February or March. *H. convergens* appears to leave its caches a few days earlier than do *sinuata* and *quinquesignata*. In any case the beetles leave on days when temperatures are sufficiently high to permit normal activity. Hence the value of introducing them into the fields before that time would be questionable.

Observations on the caches on Bald Peak were made by us in

the fall and spring of each year in the period 1922 to 1942, except in the years 1925, 1928, and 1929. The numbers of the beetles in these caches varied greatly from year to year. The beetles occurred in enormous numbers following a year of great abundance of the pea aphid, *Macrosiphum pisi* (Kalt.), on the field crops, and, conversely, the caches were usually sparsely populated and the area occupied by them greatly reduced when the previous season had been one in which the pea aphid was not abundant in the fields of the surrounding area. In some years there is a considerable mortality among the beetles in the caches and the entomogenous fungus *Beauveria bassiana* (Balsamo) Vuillemin develops on many of them.

That coccinellid larvae and adults are voracious feeders on aphids has been demonstrated by feeding records published by Palmer (1914), Clausen (1915, 1916), Cutright (1924), and Stehr (1930). Such records are not comparable because of differences in the species of aphids fed and the physical conditions under which the experiments were carried on. In 1921 Miss Keen carried on similar experiments at Forest Grove with several species of coccinellids, using *Macrosiphum pisi* as food, at unheated room temperatures (rarely exceeding 70°F.) in May and June for the adults and in July for the larvae. Her findings are abstracted as follows:

Hippodamia sinuata: 5 larvae ate a mean of 306±44 aphids each in a larval period of 21 days (3)[3] and 33 to 35 days (2), the most eaten in 1 day by 1 larva being 28. Five adults ate a mean of 380±11 aphids each in 31 days, the most eaten in 1 day by 1 beetle being 21. The average life of the adult beetles in cages was 83 days after collection.

H. quinquesignata: 6 larvae ate a mean of 245±39 aphids each in a larval period of 11 days (2), 17 to 19 days (3) and 33 days (1), the most eaten in 1 day by 1 larva being 30. Four adults ate a mean of 336±8 aphids each in 31 days, the most eaten in 1 day by 1 beetle being 18. The average life of the beetles in cages was 73 days after collection. It should be noted that variations in the length of the larval period, and consequently in the number of aphids eaten, were considerable in the case of this species and also in that of *H. sinuata*.

[3]Figures in parentheses indicate the number of specimens reared.

H. convergens: 4 larvae ate a mean of 207±7 aphids each in a larval period of 22 to 23 days, the most eaten by 1 larva in 1 day being 27. Two adults ate an average of 308 aphids each in 31 days, the most eaten in 1 day by 1 beetle being 20. The average life of the adult beetles in cages was 67 days after collection.

H. tredecimpunctata tibialis (Say)[4]: 3 larvae ate a mean of 198±2 aphids each in a larval period of 26 to 27 days, the most eaten by 1 larva in 1 day being 15. One adult ate 342 aphids in 31 days, the most eaten in 1 day being 18. This adult lived 59 days after collection.

H. lunatomaculata Motschulsky[2]: 4 larvae ate a mean of 224±9 aphids each in a larval period of 22 to 25 days, the most eaten in 1 day by 1 larva being 21. Four adults ate a mean of 302±7 aphids each in 31 days, the most eaten in 1 day by 1 beetle being 14. The beetles lived an average of 67 days after collection.

Coccinella trifasciata Linnaeus[4]: 2 larvae ate an average of 175 aphids each in a larval period of 27 days, the most eaten by 1 larva in 1 day being 15. Three adults ate a mean of 295±9 aphids each in 31 days, the most eaten by 1 beetle in 1 day being 19. The beetles lived an average of 85 days after collection.

Cycloneda polita Casey[2]: 2 larvae ate an average of 148 aphids each in a larval period of 17 to 19 days, the most eaten by 1 larva in 1 day being 15. Four adults ate a mean of 344±12 aphids each in 31 days, the most eaten in 1 day by 1 beetle being 14. The beetles lived an average of 48 days after collection.

These experiments demonstrated that the three species of *Hippodamia* that are known to have the habit of massing in caches, namely *sinuata, quinquesignata,* and *convergens*, are important predators on aphids in this area. In these counts *convergens* ate fewer aphids than the others.

In the Willamette Valley all these species are common on vetch and alfalfa, and on Austrian winter field peas infested by the pea aphid. Vetch, whether infested by aphids or not, attracts large numbers of coccinellid beetles, as Ewing (1913) has also noted. This is probably because the beetles often feed at the nectaries on the stipules. The same is true for alfalfa. Lady beetles do not appear to be attracted to peas unless aphids are abundant, and it has been our experience that syrphid larvae, often hatched from

[4]Determined by M. C. Lane.

eggs laid on the plant tips in anticipation of aphid infestation, are usually better predators on that host plant than are lady beetles. *Hippodamia lunatomaculata* was noted in abundance only on red clover when the host plants were heavily infested by the clover head aphid, *Anuraphis bakeri* (Cowan). *H. quinquesignata* usually outnumbered other *Hippodamia* on vetch. *H. sinuata* was abundant on alfalfa on April 27, 1933, and on corn in September 1931. *H. tibialis* were not found in large numbers on any of the field crops. *Coccinella trifasciata* was sometimes more abundant than *Hippodamia* on vetch and alfalfa. *Cycloneda polita* was commonly found on vetch and alfalfa. In some years *Adalia bipunctata* (Linnaeus) became abundant on aphid-infested Austrian peas and vetch in some fields. *Coccinella transverso-guttata* Fald. was much more abundant, on alfalfa, east of the Cascade Mountains than in western Oregon. *Hippodamia apicalis* Casey[2] was also a very common species on alfalfa in eastern Washington and eastern Oregon.

In 1941 and 1942 a rotary trap[5] was operated at Forest Grove by J. C. Chamberlin, of this Bureau, and I was permitted to examine the catch for coccinellids. In 1941 *Hippodamia convergens* was caught as early as February 19 and 20 at 60°F.; *Adalia bipunctata* on March 6, at 62°, and the first *H. quinquesignata* and *Coccinella trifasciata* on March 7 at 66°. The total catch in 1941, February 18 to May 15, was as follows: *Hippodamia quinquesignata* 694 (possibly some spotless forms of *H. convergens* were included in this count), *Adalia bipunctata* 521, *H. convergens* 477, *Coccinella trifasciata* 347, *Cycloneda polita* 273, *H. sinuata* 173, *H. lunatomaculata* 4, and *Coccinella transversoguttata* 2. As many as 143 *H. quinquesignata,* 113 *H. convergens,* 61 *Cycloneda polita,* and 60 *Coccinella trifasciata* were caught in one 24-hour period on warm days in April and May. The preceding year had been one of pea aphid abundance. The total catch in 1942, April 19 to June 5, was as follows: *Cocinella trifasciata* 185, *Hippodamia sinuata* 129, *H. quinquesignata* 125, *Cycloneda polita* 93, *Adalia bipunctata* 48, *H. convergens* 14. The trap was not set out early enough to get the first movement of coccinellid beetles and it was located in a different place from that in 1941, but the drop in numbers in April and May was striking as compared with 1941.

The conclusions are that coccinellid beetles are worthy of pro-

[5]For description of trap see U. S. Bur. Ent. and Plant Quar. ET-163, 6 pp. (1940) (Processed.) and Mosquito News, 5 (1): 8-16; illus. (1945).

tection, not only from the ignorant or careless but also from well-meaning exploiters of the massing habit of some species, especially as the exploiters may be "robbing Peter to pay Paul." The caches of these lady beetles are valuable natural assets and should be conserved as such. They are more common and widely distributed than is generally known, and no one knows whence the beetles come to them nor whither they go. The caches are vulnerable to fire and some insecticides.

Literature Cited

Carnes, E. K.
1912. Collecting ladybirds (Coccinellids) by the ton. Calif. Dept. Agr. Monthly Bul. 1 (3): 71-81, illus.

Chapin, Edward A.
1946. Review of the New World species of *Hippodamia* Dejean. Smithsn. Inst. Misc. Collect. 106 (11): 1-45, illus.

Clausen, C. P.
1915. A comparative study of a series of aphid feeding Coccinellidae. Jour. Econ. Ent. 8 (5): 487-491.
1916. Life history and feeding records of a series of California Coccinellidae. Calif. Univ. Pubs., Ent. 1 (6): 251-299.

Cutright, Clifford R.
1924. Bionomics of *Hippodamia trideceum-punctata* L. Ann. Ent. Soc. Amer. 17: 188-192.

Davidson, W. M.
1924. Observations and experiments on the dispersion of the convergent ladybeetle *(Hippodamia convergens* Guérin) in California. Amer. Ent. Soc. Trans. 50: 163-175.

Douglass, J. R.
1930. Hibernation of the convergent ladybeetle, *Hippodamia convergens* Guér., on a mountain peak in New Mexico. Jour. Econ. Ent. 23 (1): 288.

Eddy, C. O.
1939. An attempt to colonize *Hippodamia convergens* Guér. Internatl. Soc. Sugar Cane Technol. Cong. Proc. 6: 385-386. In Rev. Appl. Ent. A, 28: 245, 1940.

Ewing, H. E.
1913. Notes on Oregon Coccinellidae. Jour. Econ. Ent. 6(5): 404-407.

Garman, Phillip
1936. Control of apple aphids with California ladybeetles. (35th Ann. Rpt.) Conn. Ent. Bul. 383: 356-357.

Gillette, C. P.
1923. Ladybeetle, *Hippodamia convergens* Guér., hibernation notes. Colo. State Ent. Rpt. 14: 20.

HEDRICK, U. P.
1934. Division of Entomology. N. Y. State Agr. Expt. Sta. (Geneva) Rpt. 54: 56.
KNOWLTON, G. F., C. F. SMITH, AND F. C. HARMSTON
1938. Pea aphid investigations. Utah Acad. Sci. Proc. 15: 71-80.
NUNENMACHER, F. W.
1910. The Pacific Coast Entomological Society. Ent. News 21: 432.
PACKARD, C. M. AND ROY E. CAMPBELL
1926. The pea aphid as an alfalfa pest in California. Jour. Econ. Ent. 19(5): 760-761.
PALMER, MIRIAM
1914. Some notes on life history of ladybeetles. Amer. Ent. Soc. Ann. 7(3): 213-238, illus.
SHERMAN, FRANKLIN
1938. Massing of convergent ladybeetles at summits of mountains in Southeastern States. Jour. Econ. Ent. 31(2): 320-322, illus.
STEHR, WILLIAM C.
1930. The Coccinellidae (lady beetles) of Minnesota. Minn. Univ. Tech. Bul. 75: 5-54.
TIMBERLAKE, P. H.
1919. Notes on the North American species of *Hippodamia*. N. Y. Ent. Soc. Jour. 27(3 and 4): 162-174.

TRYPANOSOMA CRUZI REVEALED IN CALIFORNIA MICE BY XENODIAGNOSIS

SHERWIN F. WOOD *
Life Sciences Department, Los Angeles City College, Los Angeles

INTRODUCTION

Brumpt[1] introduced the term xenodiagnosis for a method of detecting trypanosomes in mammal hosts by feeding laboratory-bred reduviid bugs upon the animal. While studying the blood parasites of mammals at the San Joaquin Experimental Range near O'Neals, California, the writer exposed 186 captured mammals to 670 feedings by 612 cone-nosed bugs. The majority of these insects were 1st instar nymphs of the species of *Triatoma* used and 3rd and 4th instar nymphs for the *Paratriatoma*. All bugs were laboratory raised or examined prior to feeding so were known to be free of trypanosomes. The largest number fed on any mammal

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